

GSA's comments in answer to the FCC's IB Docket No. 17-16 on provisioning of a waiver for the use of Galileo in the United States

This document contains answers to the requests for comments released in the FCC Public Notice (PN) reference DA 17-18 concerning a request from the European Commission for the FCC to grant a waiver so that “non-Federal receive-only earth stations within the United states [can] operate with signals of the Galileo Radionavigation-Satellite Service (RNSS) system. Specifically, this document addresses the subsection “Public Interest Benefits and Other Considerations” of the PN.

“We request comment on the specific types of infrastructure services or applications that would benefit from operating Galileo-capable receivers in the United States:”

- **“What particular consumer applications would benefit?”**

Global Navigation Satellite Systems (GNSS) benefit applications in many fields. The latest edition of the European GNSS Agency's GNSS Market Report¹ classifies these applications into eight market segments:

Location-based services (LBS): applications based in location aimed at mass markets. The most common device used today for such services is the smartphone.

Road: finding a route using the road network to get from A to B. The most common device used is colloquially referred as “the GPS” of the car.

¹ European GNSS Agency, “GNSS Market Report,” Issue 4, 2015
https://www.gsa.europa.eu/system/files/reports/GNSS-Market-Report-2015-issue4_0.pdf

Aviation: Assisting pilots with flight operations, such as landing.

Rail: provide positioning and navigation information for trains, especially in zones where traffic is low density and therefore investing in more classic monitoring technologies would not be economically viable.

Maritime: Navigation and positioning of vessels in sea and other water bodies.

Agriculture: Increasing precision and allowing automation of ploughing, harvesting, and spreading operations incrementing the yield of farms and reducing their environmental impact. The typically used device is a tractor equipped with “a GPS.”

Surveying and Mapping: Professional mapping and surveying applications, for example used in cadastral surveys or oil exploration and exploitation.

Timing and synchronization: GNSS provides cheap and easy access to an atomic-clock precision time reference. This is used for synchronizing telecommunication networks, power grids, and for time stamping by financial institutions.

All of the applications listed above would benefit to a certain extent from having Galileo. Yet the ones that could see immediate benefits would be those related to mobility in urban environments: LBS and Road. Surveyors will also benefit from having an improved geometry of constellation due to the changing conditions of their work (e.g. one day they might be surveying a park with a clear sky view, and another they could be at a corner, beside a 25 story building that blocks half or more of the GPS satellites).

In order to calculate its position, a receiver needs to have at least four satellites in view but that is not enough for accurate positioning: the satellites should be as widely dispersed in the sky as possible to avoid “dilution of precision,” a technical term referring to the reduction of position fix precision due to poor geometry of the satellites in view. This is particularly true for LBS and road devices going around in cities: there can be long streets flanked by tall buildings that reduce the amount of satellites in view (situation known as an “urban canyon” environment) forcing the receiver to use those clearly in view even if their sky distribution leads to reduced positioning precision. **Galileo will provide additional satellites that will greatly increase the probability of determining the position with a good geometry for the satellites in view.**

- **Are there other types of applications that would benefit?**

All of the application domains mentioned above will benefit from Galileo. For Surveying & Mapping, Agriculture and Maritime users, Galileo will provide added-value services via the Commercial Service (CS). According to the European Commission's Implementing Decision² the CS will offer two main features (to paying customers):

- High precision: "enhance the quality of the data provided by the system under the Galileo programme so that the positioning error is reduced to less than a decimeter (roughly four inches), in nominal conditions of use. It should be noted that the signals issued by other global navigation satellite systems, such as the global positioning system (GPS) of the United States, could also contribute to meeting this objective."²
- Authentication: "increase the degree of safety and prevent risks of falsification and fraud in particular. Additional features must therefore be incorporated into satellite signals in order to assure users that the information which they receive does come from the system under the Galileo programme and not from an unrecognized source."²

The first feature can be used by surveyors in, for example the oil industry, in order to determine accurately drilling locations; farmers could use it for automating machinery that will improve their yields; maritime users will be able to use this characteristic for highly critical operations in narrow spaces such as docking in crowded ports. It is worth highlighting that this service is being carefully designed so that it does not compete with existing solutions -including those provided by American companies- but to be complementary.

The second feature will be particularly appreciated by applications requiring certified Position, Navigation, and Time (PNT) solutions such as time stamping of financial transactions or offenders' monitoring by law enforcement.

Timing & Synchronization applications tend to be critical (e.g. losing synchronization in power grids may lead to power failures in the area of service) and therefore very sensitive to single points of failure. Today, when using GNSS-based receivers as clocks, GPS becomes that single point of failure.

² COMMISSION IMPLEMENTING DECISION (EU) 2017/224, February 8th 2017
<http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1486638840020&uri=CELEX:32017D0224>

Having Galileo will increase redundancy and mitigate against potentially damaging events linked to synchronization failures.

Generally speaking any applications using GNSS will profit from either a better constellation geometry, increased redundancy, or added-value services of Galileo that increase in general the functionalities available to the users.

- **Are there ways in which granting a waiver could have a detrimental impact on GPS service availability, accuracy, and/or reliability? For example, could the co-processing of both Galileo and GPS signals in certain types of receivers decrease availability, accuracy, and/or reliability?**

A properly designed receiver should be able to cope with processing data from both constellations without interference between them therefore resulting only in improvements as described above without negative effects.

Galileo has in place processes and services that inform users about any anomalies with satellites: the European GNSS Service Centre (GSC)³ publishes the “Notices Advisory to Galileo Users” (NAGUs)⁴ - similar to GPS’s NANUs- as well as status flags in the navigation message. The probability of negative impacts to a user's PNT solution from a faulty Galileo satellite is therefore not expected to be greater than from similar faults associated with GPS satellites.

The only negative effect observed so far is a slightly higher consumption of batteries during the acquisition phase, therefore slightly reducing the autonomy of the devices with GPS+GALILEO receivers. This is due to the fact that more computing power is needed during this phase when processing two constellations with different modulation methods (i.e. different correlators are needed) but the observed impact on battery consumption does not exceed 1% with regards to GPS-only receivers. This difference disappears once the receiver is in tracking mode, i.e. in normal operations.

³ <http://www.gsc-europa.eu>

⁴ <https://www.gsc-europa.eu/system-status/user-notifications>

- **We seek comment on whether there are any other benefits or concerns that should be considered by the Commission in evaluating and taking action on the requested waiver.**

The availability of more GNSS satellites to improve constellation geometry and the increase on robustness coming from the use of multi-constellation, multi-frequency, multi-services receivers will result in improvements accuracy, availability and continuity of services that will be meaningful to American users. Not only their day-to-day activities using these services will be improved thanks to these benefits, but it will be particularly noticeable in emergency situations where a quick reaction into the right location can be a difference between life and death. Therefore the additional use of Galileo in 911-like operations becomes an interesting and useful option for US emergency services.